both of which are further subdivided into beds characterized by certain leading fossils. The Maquoketa series is divided into the Transition, Maquoketa and Wykoff formations, which also comprise beds marked by the presence of certain genera.

Jules Marcou has the first installment of a paper on 'Rules and Misrules in Stratigraphic Classification.' The early history of geologic correlation is sketched, and the independent discoveries of Giraud-Soulavie, William Smith, Cuvier and Brongniart are reviewed. Direct application is then made to American geological correlation, with special reference to the Taconic and Champlain systems.

'The relation of the streams in the neighborborhood of Philadelphia to the Bryn Mawr gravel,' by F. Bascom. With the exception of the large rivers, the streams of this region are shown to be of superimposed origin, having begun on a surface covered with gravel deposits, underlying which were older crystalline and paleozoic rocks. This has made their valleys quite independent of the strike or hardness of the rocks through which they are now cutting. The age of the Bryn Mawr gravels has been uncertain, and they have been referred to the Mesozoic, the Tertiary and the Quaternary by various observers. The author shows that they cannot belong to the Quaternary and inclines to the belief that they are a member of the Potomac formation, though the data obtained from the study of the drainage system may not be sufficiently exact to precisely determine their geologic relations.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, MEETING OF JANUARY 6, 1897.

ABSTRACTS OF PAPERS PRESENTED.

I. MICROSOMES AND THEIR RELATION TO THE CENTROSOME.

THE problem of the centrosome presents itself under five heads:

1. The centrosome in caryokinesis of tissue cells.

2. The centrosome in the maturation of the ovum.

3. The centrosome in fecundation, or, more strictly, *the problem of the origin of the centrosomes which take part in the first caryokinetic division of the fertilized egg-cell.*

4. The centrosome in cells in which locomotor function is more or less well developed, as in leucocytes, pigment-cells, and some unicellular organisms.

5. The centrosome in some cells which undergo periodic growth, as in the sperm-mother-cell, the ovarian ovum, and some tissue cells. The centrosome in some ganglion cells probably belongs to this group of phenomena.

It was pointed out that these are coordinate features of one and the same problem. The different forms of the centrosome and their mode of origin, their variations under pathological conditions, their behavior during fertilization of the ovum in different forms, were examined in reference to two fundamentally opposed theories now current among cytologists.

In this connection a historical review of our knowledge of the microsomes (cytomicrosomes), as found in the observations of Hanstein, Schmitz, Schwartz, Strasburger, van Beneden, Boveri, Heidenhain, together with the author's observations on the ovarian ovum of an ascidian, was presented, and the bearing of the microsome question on the problem of the centrosome, pointing to the existence of homology between microsome and centrosome, was indicated.

The main conclusion of the paper was as follows: The living substance of the cell-body is to be regarded as composed of an element capable of dimorphic existence, with perfect freedom of transition from one to the other, under some definite condition. It can exist in the form of cytomicrosomes, or it can assume the appearance of clear, hyaline filaments, network, or vesicular structure, as the case may be. At one stage, the cell-body of a given cell, say an ovarian ovum of some organism, may be composed almost wholly of microsomes; at the next these microsomes may be transformed into hyaline cytoplasmic substance, with corresponding increase in the bulk of the cell.

In the phenomena of caryokinesis, fecundation, motion, periodic growth of the cell referred to at the beginning of the paper, both of

these cytoplasmic elements arranged in definite ways, come into play, and in the power of more or less rapid transition from one to the other is to be found an explanation of the main features of the phenomena, so far as the share of the cytoplasm, as such, is directly concerned in each process.

The results of these examinations, together with the author's unpublished work on *Ascaris*, in which it was shown that the centrosome in the *Ascaris* egg not only undergoes some periodic changes in its bulk, but totally disappears at a certain stage, were urged against the theory that the centrosome is a permanent organ of the cell.

S. WATASE.

II. CENTROSOME AND ARCHOPLASM.

A SUMMARY of the conclusions reached in my work on the egg of the earthworm (*Allolobophora fœtida*) follows:

1. The attraction spheres, both male and female, are of cytoplasmic origin.

2. The archoplasm is a specific substance, and not a mere thickening of the cytoplasmic network.

3. The microsomes are morphological elements and not merely varicosities of the cytoplasmic threads. They vary greatly in size, and many of them are unmistakably independent of the cytoplasmic reticulum.

4. Five observations were urged as evidence that the archoplasm is a specific substance and of a fluid nature. These observations were: (1) the relatively rapid movement of the substance, (2) the changes in its distribution caused by fixatives, (3) its transparent appearance in the living egg, (4) the cytoplasmic reticulum is not lessened by its aggregations, nor (5) disturbed by its migration.

KATHARINE FOOT.

III. CENTROSOME AND SPHERE IN THE OVARIAN STROMA OF MAMMALS.

THE cells of the ovarian stroma of some mammals (dog, rabbit) appear to undergo a peculiar change during pregnancy. The small, indistinctly defined, elongated or polyhedral cells are no longer seen, but their place is occupied by polyhedral cells of many times their size. The nucleus of these cells is regular in shape and contains numerous clumps of chromatin irregularly distributed. It does not usually lie in the center of the cell, but is displaced more or less toward one side. Around the central region of the cell is observed a distinct condensation of the cytoplasm, which is very conspicuous after double staining. It is not sharply limited from the remainder of the cytoplasm, but shades gradually into it. The whole cytoplasmic network, especially around the denser part of the condensation, shows a more or less distinctly radiate structure, though there are no distinct fibres. This structure can often be traced almost to the periphery of the cell. Within the condensed portion of the cytoplasm, at or very near a point forming the center of the radiate arrangement, lies a small, deeply staining granule or, in some cases, two. This granule is very clearly shown by the use of Heidenhain's iron-hæmatoxylin, after which it differs from all other extra-nuclear structures in the cell in retaining the dark blue or black. This body is undoubtedly a centrosome, and the condensation of cytoplasm around it undoubtedly represents a 'sphere.'

Now these cells are not preparing for mitosis, and, as far as has been found, there is no evidence of any future division. Whether the cells are in process of degeneration and are replaced by new cells after the period of gestation is ended, it has been as yet impossible to ascertain, but it is probable that they are not. Moreover, the steps in the appearance of the centrosome and sphere in these cells have not been observed, so that it is not known just when or how they first become visible. No trace of them has been found, however, in the stroma of ovaries from animals which are not pregnant or have not recently borne young, nor has any evidence of mitosis been seen in the stroma proper. Mitotic figures are occasionally seen in the cells of young corpora lutea. The functions of these structures under these conditions is not clear. The relation of the histological changes in the ovarian stroma to pregnancy also needs further study.

The presence of the centrosome and sphere in cells which are not undergoing mitosis presents a problem which is at present rather ob-

scure. They have been recently found and studied in the cells of the spinal and sympathetic ganglia of the frog (Lenhossék, Dehler), in the neurochord cells of an annelid (Miss Lewis) and in ganglion cells of a snail (McClure). They have also been found in connective tissue cells, pigment cells, resting leucocytes, etc. In the great majority of non-dividing cells, however, they have not been demonstrated.

It would appear, from the observations given above, that the centrosome and sphere may have some other function in the economy of the cell, in addition to their important rôle in the process of caryokinesis. In the case of the ovarian stroma the facts presented appear to favor the view that the centrosome, as such, is not a permanent organ of the cell, but may appear and disappear according to the conditions which prevail in the life of the cell.

C. M. CHILD.

IV. THE CENTROSOMES IN THE ANNELID EGG.

MY observations have been made on the marine annelid *Chætopterus* in the endeavor to throw light on the following open questions:

1. Is there in the egg a definite structure—centrosome—not an artifact, and not identical with the 'centrosphere' or 'astrosphere'?

2. Is the centrosome 'a derivative structure arising by a modification of some pre-existing element in the cell,' or is it 'a permanent and ultimate organ of the cell, an organ *sui generis*, and coexistent with other ultimate organs of the cell, as the nucleus and the cytoplasm'?

3. Do the centrosomes grow, multiply by self-division, and persist from one cell generation to another, or are they formed anew in each cell in anticipation of caryokinesis?

4. What rôle does the centrosome play in fecundation—'its bearing on the phenomena of inheritance'? Is there a union of male and female centrosomes during fecundation similar to that of the male and female pronuclei—a 'quadrille of the centers'?

5. Whence come the centrosomes of the first and succeeding cleavage spindles?

6. What is the relation of the centrosome to the centrosphere (astrosphere)? To the cytoplasmic rays and network? To the Zwischenkörper?

If the eggs are kept in sea water for half an hour or more and not fertilized, all except the smaller ovarian eggs are found to have the first maturation spindle well formed, in its definitive position, and always in the same stage of development, *i. e.*, the metaphase or equatorial-plate stage. But if the eggs are preserved after having remained only a few minutes in sea water they are all, so far as my experience goes, found to contain the germinal vesicle and no spindle. I infer from this that sea water in some way stimulates the egg to the production of maturation spindles.

The smallest ovarian eggs are characterized by their relatively large nuclei and by their compact cytoplasm, which, devoid of yolk, stains a deep purple with our method—iron-alum hæmatoxylin and orange G. I can find in such eggs nothing resembling or indicating a centrosome.

Yolk granules which stain yellow soon begin to accumulate in the cytoplasm and the eggs grow larger. The yolk, however, is not at first distributed uniformly throughout the cytoplasm, but is most abundant near the periphery of the egg and frequently also immediately outside the nucleus. Where the yolk is present one can readily distinguish a cytoplasmic network, in the meshes of which yolk is held. The threads of the network have the appearance of minute granules arranged in linear order. They form a sort of membrane at the periphery of the egg, and are continuous with the nuclear membrane.

But up to the time when the egg has attained about two-thirds its full size there remain masses of cytoplasm containing no yolk and consisting of a network closely compact and staining dark purple. The component threads of these cytoplasmic masses are evident enough, and are continuous with the rest of the cyto-reticulum. These masses I consider to be equivalent to the *nebenkerne* or paranuclei of authors. They vary in shape and number in different eggs and at different stages of development, now appearing as one or two crescentic masses about the nucleus, and now broken up into many pieces. Their fate is always the same; they gradually fray out and become resolved into the general cyto-reticulum.

When the last traces of the paranucleus have vanished the cytoplasm presents a nearly uniform appearance throughout. The reticulum is characterized at this stage by the decidedly granular composition of the fibrils and the circular appearance of the meshes as seen in section, and also by the uniform distribution of yolk throughout the egg.

Although the structure of the reticulum, the peripheral egg membrane (pellicle) and nuclear membrane are beautifully clear and easily demonstrable, there is *as yet no trace of anything suggesting a centrosome.*

Soon after this, as the egg grows larger, the cytoplasmic threads show a tendency to an arrangement in straight lines rather than curves, so that the outlines of the meshes are polygonal rather than circular. Eggs which have reached this stage in development, when placed in sea water, continue to develop as far as the formation of the first maturation spindle. The tendency of the fibrils of the network toward straightening out becomes accentuated, so that many of them extend in straight lines for a distance several times the diameter of the single meshes. Moreover, these longer fibrils radiate from common centres, and in this way there arises in the cytoplasm a number of *miniature asters.* At first only two or three rays may be seen; then they increase in number and length at the direct expense of the remaining network. The aster formation continues until a climax is reached, when one can count no less than *seventy-five distinct asters* scattered about through the cytoplasm in the vicinity of the meshes. (Many of them are half way between nucleus and periphery of the egg.) These asters repel the yolk as do those of the caryokinetic spindle.

The period of development characterized by multiple asters is not of long duration. Two of the asters gain predominance over the others in point of size, and continue to grow larger, while the others gradually evanesce. The two larger asters I will call *primary*, and the others *secondary* asters, following Reinke, who has described a similar aster formation in the peritoneal cells of the larval salamander.

Whether the primary asters are formed directly by an actual union and evanescence of several of the secondary asters, I am not prepared to say at present. Many things indicate that this is the case. At any rate, the two primary asters continue to grow; a minute dark brown sphere, the centrosome, appears in the center of each, itself surrounded by a lighter brown area, astrosphere, or centrosphere, from which the purplish rays diverge in every direction. I am convinced that these two asters and their centrosome are formed by a modification of cytoplasmic structures. They usually *arise at a considerable distance from each other* and from the germinal vesicle, and while the nuclear membrane and the nucleolus are still intact. *They are the asters and centrosomes of the first maturation spindle.*

After the spindle is formed, it remains for a little while near the germinal vesicle. Each centrosome divides into two; the nuclear membrane disappears; the chromosomes and the nucleoli are drawn up to the region of the equator of the spindles, and the whole spindle swings around to its definitive position at the periphery of the egg, and perpendicular to the surface. The light brown astrospheres at the poles of the spindle contain each a pair of centrosomes. The spindle remains in this condition until the egg is fertilized.

I have artificially fertilized the eggs of *Chætopterus* after they had been in sea water an hour and twenty minutes, yet they developed normally. Immediately after the entrance of the sperm the maturation processes are resumed. The first maturation spindle, which has remained up to this time in the equatorial-plate stage, now passes through the succeeding phases of mitosis, which result in the formation of the first polar globule. During these processes the two centrosomes in the aster at the inner pole of the spindle move apart, and a small central spindle is formed between them. The centrosphere fades away and the rays of protoplasm converge to the two centrosomes. The centrosomes at the outer pole of the spindle are carried into the polar globule and there degenerate. A delicate Zwischenkörper is formed at the junction of the polar globule and egg, but it soon vanishes and has nothing to do with the formation of the second maturation spindle. (Compare Mathews, Jour. Morph. X., No. 1, p. 334.) The small spindle before

mentioned becomes the second maturation spindle by means of which the second polar globule is extruded.

The two centrosomes, which, as we have seen, are identical with those in the inner aster of the first maturation spindle, move still further apart and, with spindles between them, take a position on either side of the group of chromosomes left in the egg after the first division. Tho chromosomes are arranged in the equatorial plate, and the whole spindle swings around to an approximately vertical position directly under the first polar globule. The radiations from both ends of this spindle are long and conspicuous. The centrosome at the inner end usually, perhaps always, divides into two. It is surrounded by a small centrosphere.

The second polar globule is formed by the usual process of mitosis. In the second polar globule, as in the first, there can be seen for a time the degenerating centrosome of the outer pole of the spindle. A Zwischenkörper is formed, consisting at first of a circle of small dots, like the middle plate of plants, with rays extending in both directions. Later it becomes constricted to a single center with diverging rays, and in this condition it is distinguishable until the pronuclei have nearly united. The chromosomes left in the egg at the inner end of the spindle group themselves so as nearly to surround the centrosome and its astrosphere. The rays of the latter are numerous and long, extending through half the diameter of the egg.

The nine chromosomes swell up into as many vesicles which migrate toward the middle of the egg, and as they do so unite to form one large female pronucleus. The aster and centrosome are carried along with the vesicles for a certain distance, but degenerate before the vesicles have united. The rays of this aster, which were very strongly developed when the vesicles were first formed, become weaker and weaker, and finally disappear entirely. While they are still present they converge to the center of the group of vesicles and indicate the position of the centrosome.

While the processes of maturation have been going on, the entrance of the sperm has wrought profound changes in other parts of the egg. The sperm may apparently enter the egg anywhere. Soon after it has entered we find near it a minute aster with two centrosomes close together. They lie in a minute astrosphere from which a few short rays diverge.

These two centrosomes are known as the 'male centrosomes,' though in *Chætopterus* I am not sure that they are actually carried in by the spermatozoön. A strong presumption is created in favor of this view by the fact that the sperm has in the middle piece two bodies resembling centrosomes. However this may be, the male centrosomes separate as the head of the spermatozoön enlarges, to form the male pronucleus, and as they separate, the rays diverging from them become more and more extensive.

Besides moving apart, the centrosomes migrate toward the center of the egg, the male pronucleus accompanying them, sometimes on one side and sometimes on another, but always near at hand. They finally take a definite position a little to one side of the center of the egg and toward the polar globules. The central spindle which has developed between them lies at right angles to the egg axis. At this time nearly all the cytoplasm of the egg appears in the form of varicose fibrils, radiating directly from the two male centrosomes.

These enormous male asters are the poles of the first cleavage spindle. They are already connected by a central spindle. The pronuclei come together between the poles and elongate slightly. The nuclear membrane disappears; the chromosomes arrange themselves in the equatorial plate usually in two distinct groups, and we have the first cleavage spindle in the metaphase.

During the formation of the cleavage spindle a centrosphere develops about each centrosome, and the rays become very much shorter, for their distal portions break up to form again a cytoreticulum.

While the chromosomes are undergoing the longitudinal splitting, each centrosome divides into two in anticipation of the next cleavage. The two daughter centrosomes move apart in each astrosphere without disturbing the spherical shape of the latter, until the beginning of the telaphase, when the chromosomes at either

pole of the spindle commence to swell up into vesicles in preparation for the reconstitution of the nuclei. Then the centrospheres fade away and the centrosomes with the central spindle between them move further apart to opposite sides of the new nucleus. At this stage we find once more the enormous radiation directly from the centrosomes which involves nearly all the cytoplasm in the egg.

When the new nuclei have reached the so-called resting stage the centrospheres develop again, the distal part of the rays break up into the network, the centrosomes divide, and the processes just described are repeated.

With each cleavage a beautiful Zwischenkörper is developed. It consists at first of a circle of small dark bodies staining like the centrosomes, each with a brush of fibrils diverging toward the newly formed nuclei. At a later stage these bodies all become compressed into a single mass and lose their individuality.

The phenomena exhibited in the egg of *Chætopterus* lead me to the following conclusions:

1. That there is in the egg a definite body—the centrosome—which is not an artifact nor a myth, and which is not identical with the centrosphere or astrosphere, though the latter is sometimes present.

2. That in the oocyte of the first order, *i. e.*, the unmaturated egg, the centrosome arises by a modification of pre-existing cytoplasmic structures.

3. That the centrosomes, whatever their origin, are capable of growth and multiplication and persist through at least several cell generations.

4. That there is no union of male and female centrosomes during fecundation—no quadrille of the centers. The female centrosomes, on the contrary, entirely degenerate, and therefore the centrosomes cannot be considered a special means for conveyance of hereditary qualities.

5. The centrosomes of the first and succeeding cleavage spindles are identical with, or derived directly from, the male centrosomes, which are probably brought into the egg with the middle-piece of the spermatozoon.

6. The centrosphere, a differentiated region about the centrosome, gives a different reaction from the centrosomes, on the one hand, and the rest of the cytoplasm on the other, both in point of color and resistance to certain reagents.

Corrosive, acetic and other reagents will sometimes completely destroy the centrosphere, though the rays and other structures are fairly well preserved.

The centrospheres, unlike the centrosomes, come and go with each succeeding caryokinesis. When they are present, the cytoplasmic rays of the aster are less strongly developed then when they have disappeared, and the rays diverge directly from the centrosomes themselves.

The centrosomes divide and move apart within the centrosphere for a considerable distance without altering the shape of the latter.

A. D. MEAD.

V. THE CENTROSOME PROBLEM AND AN EXPERIMENTAL TEST.

IT is now generally supposed that the centrosome represents 'the especial organ of cell division,' 'the dynamic center of the cell.' The outcome of investigation as generally understood is well stated by Dr. Wilson in his recent work on 'The Cell' (p. 171):

"From the father comes the centrosome to organize the machinery of mitotic division by which the egg splits up into the elements of the tissues, and by which each of these elements receives its quota of the common heritage of chromatin. Huxley hit the mark two score years ago, when, in the words that head this chapter, he compared an organism to a web of which the warp is derived from the female and the woof from the male. What has since been gained is the knowledge that this web is to be sought in the chromatic substance of the nuclei, and that the centrosome is the weaver at the loom."

The evidence as to the origin and function of the centrosome is not all in yet, and some of what is in cannot be easily reconciled with these generalizations. How very difficult it is to reach certainty in observations on this structure, no one knows by his own experience better than Dr. Wilson himself. That the centrosome comes from the mother in parthenogenetic eggs is one fact about which no doubt

can be raised. Two cases are now known in which the same thing is claimed for fertilized eggs (*Myzostoma*, *Unio*), and the work of Miss Foot on the egg of *Allolobophora fœtida* suggest that the so-called sperm-aster may not, after all, be a derivative from the sperm. Mead's discovery of numerous asters in the unfertilized egg of *Chætopterus* suggests that these structures and the centrosome as well are but transient figures of the cytoplasmic network—figures that may appear at any number of points of the cell body on occasion. In that case their disappearance would not indicate degeneration, but merely a return to the reticular condition, a resolution of figure rather than of substance. This view would accord with the theory of the centrosome advanced by Dr. Watase.

The question as to which sex determines the pace of development, or whether both sexes share in this determination, is one for which it is possible to find a crucial, experimental test. My experiments are not yet concluded,' but they already furnish a decided answer to the main question. The experiments are made by crossing different species of pigeons having different incubation periods. The crosses first made, and the only ones thus far fruitful, were between the common dove ♂ and the ring-dove ♀ (*Turtur risorius*). The incubation period of the male species is from 18 to 20 days, while that of the female species is from 14 to 15 days. If the male furnishes the centrosome we should expect to have the rate of development retarded and the incubation possibly prolonged to the time of his species. In the reverse experiment, with a male *T. risorius* and a female common dove (experiment now in progress), the rate of development would be accelerated, and the time of incubation correspondingly shortened. One pair have hatched young three times, each time in the period of the mother. A second pair (♂ = a fantail) have hatched once, also in the regular time of the mother. The young birds were perfectly formed.

These experiments show that the rate of cell-formation and embryonic development up to the time of hatching is determined by the sex that furnishes the egg. Some marks of paternal derivation are already visible in the newly hatched hybrid, *e. g.*, color of the beak and character of the down. The male influence is most predominantly marked in the later development and color of the plumage.

C. O. WHITMAN.

BIOLOGICAL SOCIETY OF WASHINGTON, 270TH MEETING, SATURDAY, JANUARY 16.

THEO. HOLM showed the Society a botanical work printed in the year 1549, in which binomial nomenclature was in use. This book was Leonhart Fuchs' Historie des Plantes, and it was surprising to see that several of our common plant-names used to-day were also known at that very early date, for instance: *Vitis vinifera*, *Aconitum lycoctonum*, *Angelica silvestris*, *Digitalis purpurea*, etc.

Mr. Holm also showed the first and the last volume of the famous work 'Flora Danica,' which contains illustrations of 3,240 plants from Denmark, Norway, Sleswic, Færœ islands, Iceland and Greenland engraved on copper. This work was begun in the year 1761, the expense being paid by the Danish king until 1883, when the publication was brought to a close. The botanical editors of the work were Oeder, O. F. Mueller, M. and I. Vahl, Hornemann, Drejer, Schouw, Leibmann, Japetus Steenstrup and Lange, while six Danish kings contributed the funds necessary for the publication of this voluminous opus.

Mr. Holm thereupon showed a specimen of the interesting *Draba hyperborea*, which had lately been collected by Mr. Macoun on the Pribilof Islands. This species is not only of gigantic size in proportion to the other species of *Draba*, but it is also most characteristic in having a monopodial ramification. The species of *Draba* are generally annual, biennial or perennial, but have constantly a terminal inflorescence. In *Draba hyperborea*, on the contrary, the bud is terminal, but purely vegetative and lasts for several years, while the inflorescences are all lateral. A similar case was known to the speaker to exist in *Arabis dentata*, which, in this respect, showed a difference from most of, if not all, the other species of *Arabis*.

W. T. Swingle exhibited specimens of two simple algæ from the Gulf of Naples, remarkable for the great size of the apicial cells. Although very similar in appearance, these two

species differed fundamentally in the manner of their growth.

Specimens of two poisonous plants were exhibited by V. K. Chesnut. The first was a new species of Water-Hemlock (*Cicuta vagans* Greene), the rhizome of which is poisoning cattle in Oregon and Washington. The second was the oleander or Laurier Rose (*Nerium oleander* L.). This plant was recently mistaken at Jesus Maria, Chihuahua, Mexico, for the mountain, or rose, laurel (*Kalmia latifolia* L.). An extract was made from the leaves, which was added to honey and fed to some bees at that place. They were not poisoned by it, but the honey deposited by them proved to be very deleterious to two persons who ate from it. The mistake in the identity of the species was revealed by specimens obtained from the experimenter.

Under the title 'Unity or Plurality of Type Specimens in Paleontology,' Mr. David White called attention to the difference of opinion and usage between botanists or zoologists and paleontologists, particularly paleobotanists, respecting the application of the word 'Type,' such differences arising largely from the dispersion of the parts of plants and the conditions of preservation. Owing to the conditions of fossilization, most species of fossil plants are originally based on several specimens, each of which contributes characters not seen in the others. Such are coordinate or 'Co-types.' For specimens, such as fruits, leaves, preserved tissue, etc., serving as the source of additional specific characters, subsequently described or illustrated, the name 'Supplementary Type,' was advocated. Mr. White urged that any paleontological specimen that has furnished new specific characters for incorporation in the diagnosis, or for illustration, is thereby removed from the level of other specimens in the collection, and therefore deserves an appropriate designation, according to circumstances. Preferring for such purpose some qualification of the word 'Type,' he tentatively suggested for certain presented cases the terms 'Subsidiary Type,' 'Continental type,' etc.

Mr. White also exhibited specimens of 'A New Lycopodineous Cone from the Coal Measures of Missouri,' at Clinton, together with its bracts, presented to the National Museum by Dr. J. H. Britts. These illustrated his previous remarks, the former belonging to the genus *Lepidostrobus*, the latter of the genus *Lepidophyllum*.

Mr. Edward L. Greene spoke of the 'Development of the Idea of a Genus,' as shown in the works of the earlier herbalists and botanists.

Mr. M. A. Carleton presented a paper on the 'Ontogenetic Separation of Puccinea graminis Avenæ from P. graminis Tritici.'

The forms of *Puccinia graminis*, or stem rust, on wheat is quite distinct from the one occurring on oats, though until recently they have been considered identical. The distinction is founded mainly upon this behavior in artificial inoculations, though there are probably other reasons for separating them. The form on oats can not be transferred to any other cereal. The form on wheat is readily transferred to barley, and probably occurs on rye, and, with still less certainty, on oats. In inoculation experiments the form *Avenæ* infects 21 species of Graminæ in 18 genera. Similar experiments with the form *Tritici* are not yet completed. Eriksson has obtained like results, as a rule, in Sweden.

F. A. LUCAS, *Secretary.*

ENTOMOLOGICAL SOCIETY OF WASHINGTON, JANUARY 7, 1897.

MR. ASHMEAD exhibited an agamous female of *Belenocnema treatæ* Mayr. The true sexual generation consists of winged males and females issuing from galls on the roots of live oak, while the agamous generation consists of subapterous females issuing from a gall which occurs on the leaves. Mr. Ashmead has connected the two galls simply from a study of structural characters of the adult insects.

Professor J. B. Smith, a corresponding member, gave a brief review of a classification of the orders of insects, as a result of a series of studies made during the past few years. He proposes to divide the true 'Insecta' primarily into two series upon the character of the mouth-parts, making one a suctorial type to contain the orders Thysanura and Rhyngota. All the others are mandibulate in some stage of their existence. These mandibulata he divides into three other series, according to the development of the prothorax. In one case the prothorax is entirely free in the adult, and

this series contains the Dermaptera and Coleoptera, in which the hind wings are transversely folded, and the Plecoptera, Platyptera and Orthoptera, in which the hind wings are longitudinally folded beneath the primaries. The second series is that in which the prothorax is fairly well developed, but is quite closely attached at its base to the other segments, and is not freely movable, as in the case of the first series. In this branch, which was terrestrial from the start, are included the Isoptera, Mallophaga, Corrodentia and Neuroptera. The third series had the prothorax reduced in size from the beginning, and always united to the other thoracic segments, the general tendency being towards a complete loss of function of all save the legs in this part. All the members of this series are from an aquatic form, and they include the Odonata, Ephemerida, Trichoptera, Lepidoptera, Mecoptera, Siphonaptera, Diptera and Hymenoptera. From the Neuroptera, as generally understood, he separates the Sialidæ, which he makes, with its relatives, an order under the term Platyptera.

This paper was actively discussed by Messrs. Banks, Gill and Ashmead, who criticised details rather than the general ideas expressed.

Dr. A. D. Hopkins, a corresponding member of the Society, presented some notes on Scolytidæ, with descriptions of four new species, viz.: *Pityophthorus frontalis*, a species which infests dead oak twigs; *P. fagi*, which infests peach twigs; *Thysanoes querciperda*, infesting oak, and *T. obscurus*, reared from hickory twigs.

L. O. HOWARD,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 56th meeting of this Society, held in Washington, D. C., January 13, 1897, communications were presesented as follows:

The Measurement of Faults: J. E. SPURR, U. S. Geological Survey. Faults are simple movements in the rocks of the earth's crust along fracture planes, and, since these planes may stand in any attitude, there is no rule by which the nature of a fault may be judged beforehand. The *existence* of a fault can be determined by the evidences of friction along the plane of motion, such as fault breccia, polished and striated rock faces and so on; the amount of movement, however, can be completely ascertained only by the aid of independent and accidental phenomena. In homogenous rock masses the amount of movement cannot be ascertained; in heterogeneous rocks it may ordinarily be ascertained with greater or less accuracy, and the variations in rock masses must be used as criteria. The commonest variations which are constant enough to be reliable as data are sedimentary beds, and hence it is easy to fall into the error of considering faults simply as dislocations of strata. In careful geological work, however, any available criterion must be regarded as of as much value as any other; in mining geology the most valuable are, besides sedimentary beds, igneous bodies (such as dikes), bodies of ore, striæ on the fault plane, showing direction of movement, and the composition of the fault breccia, which may show in some degree, the amount of movement.

In seeking to measure a fault it is necessary to have clearly in mind some of the principal functions of fault movement. Among these functions certain which are of greatest importance are adopted and defined. These are: *Total displacement*, *lateral separation*, *perpendicular separation*, *throw*, *vertical separation* and *offset*. The number may be increased indefinitely, yet ordinarily this is undesirable.

Glaciation of Puget Sound Region: BAILEY WILLIS. During the past season the drift deposits about the southeastern edge of Puget Sound have been studied in some detail. They are found to consist of several beds of till, separated by stratified deposits of clay, sand and coarse gravel, together with widely distributed lignite beds. The character and extent of the glaciation of the Puget Sound region are indicated in these deposits, and it is found that the principal flow of the ice was rather from the north than from the mountains on the southeast. Two problems are presented by the phenomena: (1) the sequence of glacial advance and retreat, and the extent and duration of climatic changes indicated by the presence of lignites; (2) the bearing of the peculiar conditions of glacial development upon the physiography of the sound. Either the deeper valleys of the sound have been eroded during a period of high level from

the once more extensive sheets of drift, or, as suggested by Russell, the channels represent the beds repeatedly occupied by glaciers which, in their advance and retreat, built up the plateau-like eminences of the region, probably upon the divides of the pre-existing topography. The past condition of Puget Sound under confluent glaciation is probably now represented by the Malaspina glacier and its attendant phenomena.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

NEW YORK ACADEMY OF SCIENCES.

THE Geological Section met January 18th, and listened to the papers of which abstracts are given below. Both will appear in full in the Transactions.

The first paper was 'Notes on the Geology of the Bermudas,' by J. J. Stevenson.

After describing the several types of rock deposits and their relations, as well as the surface features of the area, Professor Stevenson offered the following conclusions respecting the successive conditions:

First: The Limestone or 'base rock' of the island was formed by accumulations of dune sand. During a prolonged period of quiet, this rock underwent great erosion, both surface and subterranean; the collapsing of cavern roofs caused great 'sinks,' some of which, no doubt, still exist as such, though to distinguish them from those of later origin would be difficult.

Second: A period of subsidence followed, during which the land sank 120 feet or more; marine deposits encroached upon the land, extending through valleys, thus giving beach rock at widely separated localities and in somewhat anomalous positions.

Third: Succeeding this was a period of quiet, during which the Sandstone was formed, as the Limestone had been, by accumulations of dune sand and the great 'sinks' were filled up, as the basins of Castle harbor are now filling.

Fourth: A period of elevation followed, during which the land must have risen to at least its former level. The old subterranean drainage system must have been re-established in many instances and the former depression cleaned out; while near systems may have been formed, causing new groups of depressions.

Fifth: This was succeeded by a period of subsidence, during which the land sank to very nearly the same position as at the maximum of subsidence in the previous period, the highest marine beds being now only a few feet above the water's edge. The more important bodies of water began in the deeper depressions early in this period, but they assumed their present forms, due to shore erosion, only in the later portion, when the subsidence was very slow and evidently interrupted more than once by prolonged periods of quiet.

The paper was well illustrated by the lantern.

The second paper was 'The Geological Section at Cliffwood, N. J.' by Arthur Hollick.

Mr. Hollick described the Cretaceous clay marl in the vicinity of Cliffwood, New Jersey, one of the localities where the fauna of the horizon has been collected and the only one at which any fossil plants have been found.

The strata in question are the equivalent of the Matawan formation of Professor W. B. Clark, which represents the transition from the plastic clays of the Raritan formation below to the greensand marl above, and, as may be expected, shows a commingling of fresh-water, land and marine conditions. The specimens collected consist of crustaceans, leaves, fruit and twigs of trees and masses of lignite. The crustaceans are too fragmentary for exact determination. About 15 species of mollusks were identified and 26 species of plants, the majority of the latter belonging to the Coniferæ. Of these, nine are here described as new species. The paper was illustrated by maps of the region, by drawings of the specimens and by the specimens themselves.

J. F. KEMP,
Secretary.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

BY invitation the New York Section of the American Chemical Society held an informal dinner at the Knickerbocker Athletic Club, Friday evening, January 8th, after which the regular monthly meeting was convened in one of the assembly rooms of the club, about fifty-five members being present.

The chair was taken by Dr. McMurtrie at 8.15, and, after routine business had been disposed of, the reading of papers was then taken up as follows:

'Note on an Improved Specific Gravity Bottle for Liquids,' by Dr. E. R. Squibb; 'Note on the Determination of Caffeine,' by G. L. Spencer; 'Variations in the Composition of Commercial Red Lead,' by Durand Woodman; 'The Methods for Determination of Tannin,' by J. H. Yocum; 'Modern Metallurgy of Copper,' by J. B. F. Herreshoff.

Mr. Spencer reviewed the precautions necessary in the determination of caffeine by both Gromberg's and the gravimetric method, and concludes that the Gromberg method gives the most satisfactory results, and admits of wider application than the gravimetric method, particularly as by the latter it is difficult to obtain absolutely pure caffeine.

Dr. Woodman gave the results of a series of factory tests on commercial red leads, taking the position that the litharge removed by digestion in solution of lead acetate is simply that portion which has escaped oxidation, and is therefore a diluent merely, and a measure of the incompleteness and imperfection of the roasting process. He finds no uniformity in the amounts of the uncombined or free litharge, either in the samples which are the subject of his paper or as reported by other analysts. According to his determinations the following variations are shown:

	1	5	B.W.L.	64	C.	L.B.	B.W.L.	L.B.
Red lead...	51.0	41.0	60.0	28.0	58.0	90.0	73.5	87.5
Free litharge...	49.0	59.0	40.0	72.0	42.0	10.0	26.5	12.5

For present purposes the few per cent. of impurities were not determined, and are included, some in the red lead figures, and others in the litharge.

Mr. J. B. F. Herreshoff made an address on 'Modern Metallurgy of Copper,' reviewing briefly the historical side of the development of the copper industry in this country and pointing out the remarkable increase in its consumption, due to the advance in the applications of electricity. While the iron industry of this country is always spoken of as so enormous, and is indeed of great magnitude, it is only known to those who follow the subject very closely that the production of copper amounts to over one-half of the value of pig iron annually produced.

In 1895 the United States consumed 62.6 per cent. of its production, but in 1896 the home consumption was only about 37.5 per cent., 62.5 per cent. being exported. In the same time there was also a large increase in production.

Mr. Yocum reviewed the methods (and difficulties inherent in them) of determining tannin in barks and extracts. He considers a complete extraction of tannin at low temperatures as an impossibility, regardless of the amount of water used.

DURAND WOODMAN,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the evening of January 18, 1897, Professor H. S. Pritchett presented some results of observations on the recent sun-spots, prefacing his remarks by a general account of our present knowledge of the constitution of the surface of the sun, and of sun-spots in general, and illustrating his remarks by the use of lantern slides.

Two persons were elected to active membership.

WM. TRELEASE,
Recording Secretary.

NEW BOOKS.

Problems and Questions in Physics. CHARLES P. MATTHEWS and JOHN SHEARER. New York and London, The Macmillan Company. Pp. vii+247. $1.60.

The Mechanics of Pumping Machinery. JULIUS WEISBACH and GUSTAV HERRMAN. Authorized translation from the second German Edition by KARL P. DAHLSTROM. London and New York, The Macmillan Company. 1897. Pp. 300.

The Story of Extinct Civilizations. ROBERT E. ANDERSON. New York, D. Appleton & Company. Pp. 213.